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Macroeconomic dynamics in Argentina in the light of a structuralist-post keynesian stock-flow consistent model

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Very Preliminary

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Abstract

This working paper consists of a first attempt to bring in the most relevant contributions of the Structuralist and Post Keynesian schools of thought and put them all together within the framework of a stock-flow consistency model. This is done by incorporating some of the structural features that characterize a developing country (such as credit constrains, non-diversified production structures, a large debt burden in foreign exchange, etc.) into the traditional framework of a stock-flow consistency model. Thus, the supply-side of the economy is split into three producing sectors that interact with each other, both at the domestic and the international level. Financial transactions are incorporated in such a way that stock-flow accounting consistency is fulfilled. As an example of the potential of stock-flow consistency modeling within a structuralist framework we run an experiment in order to verify whether the model is able to reproduce the results of Thirlwall's Law.

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Introduction

This working paper consists of a first attempt to bring in the most relevant contributions of the Structuralist and Post Keynesian schools of thought and put them all together within the framework of a stock-flow consistency model in order to examine the macroeconomic performance of a developing country (say, Argentina). The reason why we aim at building a Structuralist-Post Keynesian Stock-Flow Consistent (SPKSFC) model is not random whatsoever. Starting from the success of stock-flow consistent (SFC) models at foreseeing the financial crisis that broke out in 2007, there has been a growing interest in this alternative methodology as a vehicle for understanding the way the economy works. Although a SFC model can in principle be adapted to any theoretical framework, they were the Post Keynesians who developed and promoted the most powerful advances in this methodology (the most relevant contribution in this regard is Godley & Lavoie, 2007). Thus, as of this moment, most of the SFC models that can be found in the academic literature incorporate many of the theoretical features that characterize the Post Keynesian school of thought.

However relevant the contributions of the Post Keynesians, it should be noted that most of the SFC models that they have developed (as well as the theoretical content comprised in them) though perfectly applicable to cases like the United States or the Eurozone taken as a whole, do not account for some of the structural features that distinguish developing countries, like most of Latin American States. The specificities of these economies and the lack of accurate analyses coming from the "core" gave rise to the so-called Structuralist school of thought, in the half of the 20th century. Economists like Raúl Prebisch, Celso Furtado, etc. were the most prominent representatives of this tradition and laid the foundations for a more precise analysis of the developing world. Many of these contributions were assembled in a great and still enlightening book written by Lance Taylor in 1983.

Hence, we consider that there is currently a theoretical gap regarding macroeconomic modeling applied to developing countries[2] or, at least, there is a promising opportunity to develop a new line of research that attempts to combine the most relevant contributions of the Post Keynesian and the Structuralist schools of thought. We believe that many of the strong points of the SFC model presented by Godley and Lavoie (accounting consistency, endogeneity of money, autonomous banks behavior, investment-driven savings and not the other way around, etc.) can be complemented by some of the contributions of the Structuralist school (dual economies, countries without currency sovereignty, credit rationing, partially endogenous money etc.). We expect that after this first attempt to build a SPKSFC model further research is undertaken in order to refine this model, broaden its scope of application and, ultimately, make of it an applicable toolkit for policy-making decisions.

[2] There is an interesting attempt to build a structuralist computable general equilibrium model applied to Argentina (Serino, 2009). Although there are some links between his work and the one that is developed in this working paper, there are some fundamental differences regarding accounting consistency.

The remaining of this working paper describes the model. We will first present the matrices on which the model is based and then we will describe each of the equations that constitute the model. Many of them are accounting identities and do not need much explanation. However, some of them are behavioral equations or equations that describe the structural features of the economy. In those cases we will provide the reader with the required explanations regarding the theoretical foundations that are being used and the assumptions that are being made. Finally, we will present some simulations that show some of the results that the model can yield at this early stage of its development.

The Model

The Stock and Flow Matrices

Every SFC model can be summarized in three matrices: a balance sheet, a social accounting matrix and the flow of funds matrix. The first one concerns the stocks and presents a description of all the assets, physical and financial, that are available in the economy as well as which are the sectors that may hold them as assets or liabilities. The social accounting matrix summarizes all the transactions (flows) that take place during a certain period of time (for instance, consumption, exports, wage earnings, tax payments, interest payments, etc.). The flow of funds describes the net change of financial assets among the sectors of the economy.

We will start the presentation of this SPKSFC model by presenting the balance sheet or matrix of stocks, which can be found in Table 1. The first column of the balance sheet lists all the assets that are present in the model. The first row splits the world economy into the two countries in question and the second row disaggregates each country into the different sectors. Later on we will describe the structure of the economy more in detail – it should now be sufficient to say that apart from households, banks, the government and the central bank (which appear in every SFC model) we have three producing sectors. A "+" sign indicates that the asset in question constitutes an asset for the corresponding sector, whereas a "-"sign indicates that the asset constitutes a liability. For instance, in the third row we see that Argentinean households have $+ARS_h^{AR}$, which means that pesos are an asset for them. Conversely, the central bank of Argentina, who issues those pesos, has $-ARS_h^{AR}$ since pesos are a liability for it. The last row of the balance sheet shows the net wealth of each of the sectors. Later on it will be explained why it is assumed that some sectors (firms producing intermediate goods and commercial banks have a net worth that is equal to zero). What should

be noted right now is that the sum of the wealth of all the sectors in the world economy (Argentina + Rest of the World) is equal to the total stock of capital. This is important given that financial assets do not constitute a source of net wealth for the economy as a whole (since every financial asset is matched by a financial liability of the same value).

Table 1
Balance Sheet

	Argentina							Rest of the World							
	Households	Firms "A"	Firms "N"	Firms "IC"	Banks	Government	Central Bank	Households	Firms "A"	Firms "N"	Firms "IC"	Banks	Government	Central Bank	
Pesos	$+ARS_h^{AR}$						$-ARS_h^{AR}$								0
Dollars	$+USD_h^{AR}$						$+USD_{cb}^{AR}$	$+USD_h^{RW}$						$-USD_{cb}^{RW}$	0
Deposits	$+M_h^{AR}$				$-M_h^{AR}$			$+M_h^{RW}$				$-M_b^{RW}$			0
Capital		$+K_A^{AR}$	$+K_N^{AR}$						$+K_A^{RW}$	$+K_N^{RW}$					$+K$
Loans		$-L_A^{AR}$	$-L_N^{AR}$		$+L^{AR}$				$-L_A^{RW}$	$-L_N^{RW}$		$+L^{RW}$			0
Bonds Pesos					$+Bb_{d,p}^{AR}$	$-B_{s,p}^{AR}$	$+Bcb_{d,p}^{AR}$					$+Bb_{d,p}^{RW}$			0
Bonds Dollars (AR)						$-B_{s,d}^{AR}$						$+Bb_{d,d}^{RW/AR}$			0
Bonds Dollars (RW)					$+Bb_{d,d}^{AR}$							$+Bb_{d,d}^{RW}$	$-B_{s,d}^{RW}$	$+Bcb_{d,d}^{RW}$	0
Reserves					$+R^{AR}$		$-R^{AR}$					$+R^{RW}$		$-R^{RW}$	0
Advances					$-A^{AR}$		$+A^{AR}$					$-A^{RW}$		$+A^{RW}$	0
Wealth	Vh^{AR}	Vf_A^{AR}	Vf_N^{AR}	0	0	$-B^{AR}$	Vcb^{AR}	Vh^{RW}	Vf_A^{RW}	Vf_N^{RW}	0	0	$-B_d^{RW}$	Vcb^{RW}	$+K$

Let us now present the social accouting matrix and the flow of funds, which can be found in Table 2. As we already explained, these matrices account for all the transactions that take place during a certain period of time. From these matrices we can derive all the accounting identities that consititute the SFC model and that, in turn, ensure that the model is consistent. Phrased differently, working with social accounting matrices guarantees that there are no leakeges in the model – everything must come from somewhere and go elsewhere. Let us read some of the entries of the social accounting matrix in order to explain how it should be interpreted. For instance, if we take the column corresponding to Argentinean households, it can be noted that consumption (C^{AR}) is written as the difference between disposable income (the sum of wages minus taxes plus interest income plus dividends) minus saving (net accumulation of pesos, dollars and bank deposits). This is a well-known identity that will be written in the model.

Table 2

Social Accounting Matrix and Flow of Funds

Argentina

	Households	Firms "A"		Firms "N"		Firms "IC"	Banks		Government	Central Bank	
		Current	Capital	Current	Capital		Current	Capital		Current	Capital
Consumption	$-C^{AR}$	$-ICA^{AR}$		$-ICN^{AR}$					$-G^{AR}$		
Investment			$-IA^{AR}$		$-IN^{AR}$						
Income		$+Y_A^{AR}$		$+Y_N^{AR}$		$+Y_{IC}^{AR}$					
Wages	$+w^{AR}N^{AR}$	$-w_A^{AR}N_A^{AR}$		$-w_N^{AR}N_N^{AR}$		$-w_{IC}^{AR}N_{IC}^{AR}$					
Taxes	$-Th^{AR}$	$-Tf_A^{AR}$		$-Tf_N^{AR}$		$-Tf_{IC}^{AR}$					
Interest on M	$+rd^{AR}M^{AR}$						$-rd^{AR}M^{AR}$				
Interest on L		$-rl^{AR}L_A^{AR}$		$-rl^{AR}L_N^{AR}$			$+rl^{AR}L^{AR}$				
Interest on R							$+rs^{AR}R^{AR}$			$-rs^{AR}R^{AR}$	
Interest on A							$-r^{AR}A^{AR}$			$+r^{AR}A^{AR}$	
Int. B ARS							$+r^{AR}Bb_{d,p}^{AR}$		$-r^{AR}B_{s,p}^{AR}$	$+r^{AR}Bcb_{d,p}^{AR}$	
Int. B USD (AR)									$-r^{AR}B_{s,d}^{AR}$		
Int. B USD (RW)							$+r^{RW}Bb_{d,d}^{AR}$				
Profits	$+DIV^{AR}$	$-ATP_A^{AR}$	$+(1-DIV_A^{AR})$	$-ATP_N^{AR}$	$+(1-DIV_N^{AR})$	$-ATP_N^{AR}$	$-Pb^{AR}$		$+Pcb^{AR}$	$-Pcb^{AR}$	
Δ ARS	$-\Delta ARS_h^{AR}$										$+\Delta ARS_h^{AR}$
Δ USD	$-\Delta USD_h^{AR}$										$-\Delta USD_{cb}^{AR}$
Δ M	$-\Delta M^{AR}$							$+\Delta M^{AR}$			
Δ L			$+\Delta L_A^{AR}$		$+\Delta L_n^{AR}$			$-\Delta L^{AR}$			
Δ R								$-\Delta R^{AR}$			$+\Delta R^{AR}$
Δ A								$+\Delta A^{AR}$			$-\Delta A^{AR}$
Δ B ARS								$+\Delta Bb_{d,p}^{AR}$	$-\Delta B_{s,p}^{AR}$		$+\Delta Bcb_{d,p}^{AR}$
Δ B USD (AR)									$-\Delta B_{s,d}^{AR}$		
Δ B USD (RW)								$+\Delta Bb_{d,d}^{AR}$			
	0	0	0	0	0	0	0	0	0	0	0

Let us take another example, now from the marix of the Rest of the World. If we take firms of the "A" sector (we will shortly describe what "A", "N" and "IC" go for) we can observe that investment (IA^{RW}) is given by the sum of non-distributed profits ($1 - DIV_A^{RW}$) plus loans (ΔL_A^{RW}), which is also an accounting identity that needs to be held under the current setting (if there were additional sources of financing, like equities issued by firms, this identity would be slighly modified). Another interesting example can be taken from the government. Note that the change in the debt issued by the Rest of the World ($\Delta B_{s,d}^{RW}$) is given by the gap between income (taxes plus central bank profits) and spending (government expediture plus interest payments). This is another identity that needs to hold.

Table 2 (cont)

Social Accounting Matrix and Flow of Funds

	Rest of the World										
	Households	Firms "A"		Firms "N"		Firms "IC"	Banks		Government	Central Bank	
		Current	Capital	Current	Capital		Current	Capital		Current	Capital
Consumption	$-C^{RW}$	$-ICA^{RW}$		$-ICN^{RW}$					$-G^{RW}$		
Investment			$-IA^{RW}$		$-IN^{RW}$						
Income		$+Y_A^{RW}$		$+Y_N^{RW}$		$+Y_{IC}^{RW}$					
Wages	$+w^{RW}N^{RW}$	$-w_A^{RW}N_A^{RW}$		$-w_N^{RW}N_N^{RW}$		$-w_{IC}^{RW}N_{IC}^{RW}$					
Taxes	$-Th^{RW}$	$-Tf_A^{RW}$		$-Tf_N^{RW}$		$-Tf_{IC}^{RW}$					
Interest on M	$+rd^{RW}M^{RW}$						$-rd^{RW}M^{RW}$				
Interest on L		$-rl^{RW}L_A^{RW}$		$-rl^{RW}L_N^{RW}$			$+rl^{RW}L^{RW}$				
Interest on R							$+rs^{RW}R^{RW}$			$-rs^{RW}R^{RW}$	
Interest on A							$-r^{RW}A^{RW}$			$+r^{RW}A^{RW}$	
Int. B ARS							$+r^{AR}Bb_{d,p}^{RW}$				
Int. B USD (AR)							$+r^{AR}Bb_{d,d}^{RW/AR}$				
Int. B USD (RW)							$+r^{RW}Bb_{d,d}^{RW}$		$-r^{RW}B_{s,d}^{RW}$		
Profits	$+DIV^{RW}$	$-ATP_A^{RW}$	$+(1-DIV_A^{RW})$	$-ATP_N^{RW}$	$+(1-DIV_N^{RW})$	$-ATP_N^{RW}$	$-Pb^{RW}$		$+Pcb^{RW}$	$-Pcb^{RW}$	
Δ ARS											
Δ USD	$-\Delta USD_h^{RW}$										$+\Delta USD_s^{RW}$
Δ M	$-\Delta M^{RW}$							$+\Delta M^{RW}$			
Δ L			$+\Delta L_A^{RW}$		$+\Delta L_n^{RW}$			$-\Delta L^{RW}$			
Δ R								$-\Delta R^{RW}$			$+\Delta R^{RW}$
Δ A								$+\Delta A^{RW}$			$-\Delta A^{RW}$
Δ B ARS								$+\Delta Bb_{d,p}^{RW}$			
Δ B USD (AR)								$+\Delta Bb_{d,d}^{RW/AR}$			
Δ B USD (RW)								$+\Delta Bb_{d,d}^{RW}$	$-\Delta B_{s,d}^{RW}$		$+\Delta Bcb_{d,d}^{RW}$
	0	0	0	0	0	0	0	0	0	0	0

These examples should be sufficient not only to understand the cornerstone of every SFC model, but also to realize what its strenght is: stock-flow consistent accounting ensures that there are no blackholes in the model. As long as a SFC model is correctly calibrated and accounting for the main features of the economy that it is trying to simulate, it is likely to produce results that resemble the actual macroeconomic performance of the economy in question (a good example of this success are all the papers written by Godley & Izurieta (e.g., Godley & Izurieta, 2002; Godley & Izuerieta, 2004) in the beginning of the 2000s, which were foreseeing the financial crisis many years in advance).

The Supply Side

Most of Post Keynesian SFC models start by describing the equilibrium in the goods market, which is usually assumed to be ensured through quantity adjustments. Basically, production is assumed to be demand-led since for Post Keynesians rather than resource scarcity (as stated by mainstream economists) there is resource abundance and therefore firms can almost always satisfy the demand for goods (see Lavoie, 1992). Therefore, firms set a price for their goods according to a Kaleckian mark-up pricing rule and the market is filled with as many units as aggregate demand determines given the level of income (i.e., effective demand, not an

aggregate production function, determines the level of production of the economy). However, an economy like Argentina cannot be considered to be entirely demand-led. Although this may be the case in the long run, the structure of the economy is such that in periods of unusually high effective demand, bottlenecks may appear in the supply side. Moreover, unlike a diversified economy like the US, Argentina exhibits differential levels of technology, productivity and resource availability in each of its productive sectors. Thus, reducing this unbalanced and heterogeneous productive structure to a single-good economy may be misleading. That is why in this working paper we intend to build a SFC model in which the supply side plays a more relevant role than the one that is usually played in the SFC models literature.

Following Taylor's description of and economy with an important food sector (Taylor, 1983), we assume a three-sector economy framed in a two-country model. The countries are Argentina (AR) and the Rest of the World (RW) and the goods produced by each sector are agricultural goods, non-agricultural goods and intermediate goods. Thus, we will denote "A" the sector that produces the agricultural good, "N" the one that produces non-agricultural goods and "IC" the remaining one. We will make the further assumption that good "A" is tradable (to frame the model in today's hot topics "A" could play the role of commodities like soy, meat or even petroleum (although the latter is not an agricultural good)) and that its price is determined in the international markets in such a way that global demand equals global supply, i.e., excess demand for "A" is zero. As regards "N", its production is entirely demand-led and although it is assumed to be tradable it is not as tradable as "A" since, form instance, "N" include non-tradables like services. But still, we will allow for some flows of "N" going from the Rest of the World to Argentina, as the latter tends to import many consumption and mainly capital goods from abroad. Finally, "IC" is assumed to be tradable and abundant, i.e., their supply is entirely demand-led. Table 3 describes the supply-demand interactions between the different sectors of our two countries.

On the first column of Table 3 we find all the producing sectors of the global economy: the producers of "A", "N" and "IC" of Argentina and the Rest of the World. Therefore, global GDP (which we denote Y^G) should be equal to the sum of all the sectoral productions of the six sectors of the world economy. This accounting identity can be found in the last column of Table 3. The first row of Table 3 refers to each of the countries in question, whereas the second one mentions each of the sectors that may demand the goods produced by the six aforementioned sectors.

Table 3

Matrix of Real Transactions

	Argentina					Rest of the World				
	Households	Firms "A" Current	Firms "A" Capital	Firms "N" Current	Firms "N" Capital	Government	Households	Firms "A" Current	Firms "A" Capital	Firms "N" Current	Firms "N" Capital	Government	Supply
A^{AR}	CoA_{AR}^{AR}					GoA_{AR}^{AR}	CoA_{RW}^{AR}						Y_A^{AR}
IC^{AR}		ICA_{AR}^{AR}		ICN_{AR}^{AR}									Y_{IC}^{AR}
N^{AR}	CoN_{AR}^{AR}		IA_{AR}^{AR}		IN_{AR}^{AR}	GoN_{AR}^{AR}							Y_N^{AR}
A^{RW}							CoA_{RW}^{RW}					GoA_{RW}^{RW}	Y_A^{RW}
IC^{RW}		ICA_{AR}^{RW}		ICA_{AR}^{RW}				ICA_{RW}^{RW}		ICN_{RW}^{RW}			Y_{IC}^{RW}
N^{RW}	CoN_{AR}^{RW}		IA_{AR}^{RW}		IN_{AR}^{RW}		CoN_{RW}^{RW}		IA_{RW}^{RW}		IN_{RW}^{RW}	GoA_{RW}^{RW}	Y_N^{RW}
Demand	C_{AR}	ICA_{AR}	IA_{AR}	ICN_{AR}	IN_{AR}	G_{AR}	C_{RW}	ICA_{RW}	IA_{RW}	ICN_{RW}	IN_{RW}	G_{RW}	Y^G

It is deduced from Table 3 that:

✓ Argentinean households purchase domestic agricultural and non-agricultural goods (CoA_{AR}^{AR} and CoN_{AR}^{AR}), and foreign non-agricultural goods (CoN_{AR}^{RW}). Hence, under this setting Argentina does not import agricultural goods, whatsoever. The sum of these separate demands is equal to private consumption (C_{AR}).

✓ Households of the Rest of the World purchase domestic agricultural and non-agricultural goods (CoA_{RW}^{RW} and CoN_{RW}^{RW}), and foreign agricultural goods (CoA_{RW}^{AR}). Thus, Argentina only exports "A" goods. The sum of these separate demands is equal to private consumption (C_{RW}).

✓ Argentinean firms, both belonging to sectors "A" and "N", purchase domestic and foreign intermediate goods (ICA_{AR}^{AR},ICN_{AR}^{AR},ICA_{AR}^{RW} and ICA_{AR}^{RW}) and capital goods (IA_{AR}^{AR},IN_{AR}^{AR},IA_{AR}^{RW} and IN_{AR}^{RW}). The sum of these separate demands of each type of goods adds up to aggregate demand of intermediate goods (ICA_{AR} + ICN_{AR} = IC_{AR}) and aggregate investment (IA_{AR} + IN_{AR} = I_{AR}).

✓ Firms of the Rest of the World, both belonging to sectors "A" and "N", only purchase domestic intermediate goods (ICA_{RW}^{RW} and ICN_{RW}^{RW}) and capital goods (IA_{RW}^{RW} and IN_{RW}^{RW}). As it was already mentioned, Argentina does not export any good other than "A". The sum of these separate demands for intermediate and capital goods gives

the aggregate demand flows of intermediate goods ($ICA_{RW}^{RW} + ICN_{RW}^{RW} = IC_{RW}$) and investment ($IA_{RW}^{RW} + IN_{RW}^{RW} = I_{RW}$).

✓ The Government of each country purchases domestically-produced agricultural and non-agricultural goods (GoA_{AR}^{AR} and GoN_{AR}^{AR} in the case of Argentina, and GoA_{RW}^{RW} and GoA_{RW}^{RW} in the case of the Rest of the World).

✓ The intermediate goods industry does not purchase any good from the other sectors - we are assuming that intermediate goods are produced using labor as the sole input.

We are now able to start writing the equations that will constitute the SPKSFC model. In order to do so, we will follow Taylor (Taylor, 1983) and assume that the production of "A" is equal to the capital stock of the sector (mainly, land) times a constant which captures the average productivity of capital (land). Thus,

$$Y_{A_t}^{AR} = v^{AR} . K_{A_{t-1}}^{AR} . P_{A_t}^{RW} . E_t \quad (1)$$

$$Y_{A_t}^{RW} = v^{RW} . K_{A_{t-1}}^{RW} . P_{A_t}^{RW} \quad (2)$$

Equation (1) states that nominal production of "A" in Argentina equals the stock of land (which is assumed to be fully utilized) times its average productivity (so far we get real production of "A") times the international price of "A" times the nominal exchange rate. The reason why, in order to go from real to nominal output we multiply by $(P_{A_t}^{RW} . E_t)$ instead of $P_{A_t}^{AR}$ is that the latter, as it will be defined below, may be distorted by export duties aimed at reducing the domestic price of "A". Equation (2) follows a similar but simpler rationale.

The production of the four remaining goods is demand-led. Thus, there cannot be bottlenecks and capacity utilization need not be equal to one all the time. Note that in equation (4) and (6) the demand flows of Argentina to the rest of the world are divided by the nominal exchange rate in order measure all the flows in the same currency (the currency of the producer).

$$Y_{N_t}^{AR} = CoN_{AR_t}^{AR} + IA_{AR_t}^{AR} + IN_{AR_t}^{AR} + GoN_{AR_t}^{AR} \quad (3)$$

$$Y_{N_t}^{RW} = \frac{CoN_{AR_t}^{RW} + IA_{AR_t}^{RW} + IN_{AR_t}^{RW}}{E_t} + CoN_{RW_t}^{RW} + IA_{RW_t}^{RW} + IN_{RW_t}^{RW} + G_{RW_t}^{RW} \quad (4)$$

$$Y_{IC_t}^{AR} = ICA_{AR_t}^{AR} + ICN_{AR_t}^{AR} \quad (5)$$

$$Y_{IC_t}^{RW} = \frac{ICA_{AR_t}^{RW} + ICN_{AR_t}^{RW}}{E_t} + ICA_{RW_t}^{RW} + ICN_{RW_t}^{RW} \quad (6)$$

Real output of each sector can be easily obtained by deflating nominal output by the corresponding price index.

$$y_{A_t}^{AR} = \frac{Y_{A_t}^{AR}}{P_{A_t}^{RW} E_t} \quad (7)$$

$$y_{N_t}^{AR} = \frac{Y_{N_t}^{AR}}{P_{N_t}^{AR}} \quad (8)$$

$$y_{IC_t}^{AR} = \frac{Y_{IC_t}^{AR}}{P_{IC_t}^{AR}} \quad (9)$$

$$y_{A_t}^{RW} = \frac{Y_{A_t}^{RW}}{P_{A_t}^{RW}} \quad (10)$$

$$y_{N_t}^{RW} = \frac{Y_{N_t}^{RW}}{P_{N_t}^{RW}} \quad (11)$$

$$y_{IC_t}^{RW} = \frac{Y_{IC_t}^{RW}}{P_{IC_t}^{RW}} \quad (12)$$

Price Determination

Since we are considering the transaction of three types of goods between two countries, we need to define six price-formation processes. Even though "A" is considered to be a fully tradable commodity which price is determined in the international markets (it could be argued that in this case the law of one price may hold), we still need to express the price of "A" in pesos in order to build the consumer price index of Argentina. However, as it will be shown below, the law of one price may not hold if Argentina introduces export duties aimed at both increasing tax collection and reducing the domestic price of "A" or if eventually production costs for sector "A" in Argentina increase so much that selling it at the international price yields no profits.

As it was described above, the markets of "N" and "IC" are assumed to be demand-led, i.e., supply is able to satisfy any level of demand. This may not be fully realistic for the case of sectors "N" and "IC" of Argentina, but in order to keep things simple we will make this assumption. Thus, firms decide the price of their good by setting a mark-up on labor and other input (when applicable) costs. Given the price, any excess demand of "N" and "IC" is adjusted through quantities.

$$P_{N_t}^{AR} = \left(1 + \mu_N^{AR}\right).\left(w_{N_t}^{AR}.b_N^{AR} + P_{IC_t}^{AR}.\rho^{AR}.\epsilon^{AR} + P_{IC_t}^{RW}.E_t.\rho^{AR}.(1-\epsilon^{AR})\right) \quad (13)$$

$$P_{N_t}^{RW} = (1 + \mu_N^{RW}).\left(w_{N_t}^{RW}.b_N^{RW} + P_{IC_t}^{RW}.\rho^{AR}\right) \quad (14)$$

$$P_{IC_t}^{AR} = \left(1 + \mu_{IC}^{AR}\right).\left(w_{IC_t}^{AR}.b_{IC}^{AR}\right) \quad (15)$$

$$P_{IC_t}^{RW} = \left(1 + \mu_{IC}^{RW}\right).\left(w_{IC_t}^{RW}.b_{IC}^{RW}\right) \quad (16)$$

The idea underlying equation (13) is that the price of "N" goods in Argentina ($P_{N_t}^{AR}$) is given by a mark-up rate (μ_N^{AR}) on total production costs per unit of output, which are given by the sum of labor costs (the nominal wage ($w_{N_t}^{AR}$) times the labor coefficient ($b_{N_t}^{AR}$), which is given by labor per unit of output), domestic input costs (the input requirement per unit of output (ρ^{AR}) times the share of domestic inputs that are purchased in the domestic market (ϵ^{AR}) times the price of domestic intermediate goods ($P_{IC_t}^{AR}$)), and imported intermediate goods

(the input requirement per unit of output (ρ^{AR}) times the share of imported inputs that are purchased in the domestic market ($1 - \epsilon^{AR}$) times the price of foreign intermediate goods expressed in pesos ($P_{IC_t}^{RW}.E_t$)). Equations (14 – 16) have a similar but simpler interpretation.

The market-clearing process for good "A" is rather different, since in this case it is the international price ($P_{A_t}^{RW}$) what ensures the equilibrium. In order to define the price determination of good "A", it is first necessary to write the excess demand function (this was also implicitly done for goods "N" and "IC" but since quantities are the adjusting variable the equilibrium in these markets, i.e., the situation where excess demand is null, was fulfilled automatically). The excess demand function is not numbered because it is not part of the model.

$$ED_t^A = \frac{CoA_{AR_t}^{AR} + GoA_{AR_t}^{AR}}{E_t} + CoA_{RW_t}^{AR} + CoA_{RW_t}^{RW} + GoA_{RW_t}^{RW} - \frac{Y_A^{AR}}{E_t} - Y_A^{RW}$$

As it will be shown below, household's consumption of agricultural goods is a function of both income and the price of "A". By simple algebraic manipulations that will become clear in a few paragraphs (if the reader is skeptical or anxious, she can take a glance to equations (45-54)) it can be deduced that the market clearing price of "A", i.e., the one that yields and excess demand which is equal to zero, is:

$$P_{A_t}^{RW} = \frac{\left(\frac{Y_{A_t}^{AR}}{E_t} + Y_A^{RW} - \frac{GoA_{AR_t}^{AR}}{E_t} - GoA_{RW_t}^{RW} - \frac{\alpha_s^{AR}.C_t^{AR}}{E_t} - (1-\alpha_s^{RW}).C_t^{RW}\right)}{\phi^{AR} + \phi^{RW}} \qquad (17)$$

$$P_{A_t}^{AR} = P_{A_t}^{RW}.E_t.(1 - \sigma^{AR}) \qquad (18)$$

The interpretation of the parameters that appear in equation (17) will be explained shortly. As regards equation (18), it simply states that the domestic price of agricultural goods in Argentina is given by the international price transformed by the nominal exchange rate times the complement of the export duty (σ^{AR}). This will be very useful to address the various impacts that export duties may have on the Argentinean economy.

Once the prices of all the goods have been defined, it is possible to construct the consumer price index of the economy, which will be required as an input on the wage

equations. The consumer price index is simply given by a weighted average of the prices of "A" and "N" goods. Following Engel's Law, it is natural to set $\omega^{AR} > \omega^{RW}$.

$$P_t^{AR} = \omega^{AR}.P_{A_t}^{AR} + (1 - \omega^{AR}).P_{N_t}^{AR} \quad (19)$$

$$P_t^{RW} = \omega^{RW}.P_{A_t}^{RW} + (1 - \omega^{RW}).P_{N_t}^{RW} \quad (20)$$

Wages, Employment and Labor Productivity

In order to get as close as possible to a Post Keynesian, Marxist or Structuralist theories of inflation (Lavoie, 1992; Rowthorn, 1977; Taylor, 1991) (which in fact seems to be very suitable to examine the Argentinean case) it is necessary to introduce a feed-back between wages and prices. The first step of this process has already been taken when equations (13 – 16) were written, since they depend directly on the nominal wage – as wages grow, prices increase proportionally. It is now necessary to close this loop and make the nominal wage be a function of the consumer price index, among other determinants. These remaining determinants are the nominal wage and the employment level on the previous period (this last variable is included to account for the bargaining-power effect – as employment increases labor unions may find themselves in a better position to make better deals).

$$\ln\left(w_{A_t}^{AR}\right) = \eta_0 + \eta_1.\ln\left(w_{A_{t-1}}^{AR}\right) + \eta_2.\ln\left(P_{t-1}^{AR}\right) + \eta_3.\ln\left(N_{A_{t-1}}^{AR}\right) \quad (21)$$

$$\ln\left(w_{N_t}^{AR}\right) = \eta_4 + \eta_5.\ln\left(w_{N_{t-1}}^{AR}\right) + \eta_6.\ln\left(P_{t-1}^{AR}\right) + \eta_7.\ln\left(N_{N_{t-1}}^{AR}\right) \quad (22)$$

$$\ln\left(w_{IC_t}^{AR}\right) = \eta_8 + \eta_9.\ln\left(w_{IC_{t-1}}^{AR}\right) + \eta_{10}.\ln\left(P_{t-1}^{AR}\right) + \eta_{11}.\ln\left(N_{IC_{t-1}}^{AR}\right) \quad (23)$$

$$\ln\left(w_{A_t}^{RW}\right) = \eta_0 + \eta_1 . \ln\left(w_{A_{t-1}}^{RW}\right) + \eta_2 . \ln\left(P_{t-1}^{RW}\right) + \eta_3 . \ln\left(N_{A_{t-1}}^{RW}\right) \quad (24)$$

$$\ln\left(w_{N_t}^{RW}\right) = \eta_4 + \eta_5 . \ln\left(w_{N_{t-1}}^{RW}\right) + \eta_6 . \ln\left(P_{t-1}^{RW}\right) + \eta_7 . \ln\left(N_{N_{t-1}}^{RW}\right) \quad (25)$$

$$\ln\left(w_{IC_t}^{RW}\right) = \eta_8 + \eta_9 . \ln\left(w_{IC_{t-1}}^{RW}\right) + \eta_{10} . \ln\left(P_{t-1}^{RW}\right) + \eta_{11} . \ln\left(N_{IC_{t-1}}^{RW}\right) \quad (26)$$

Employment (N) is also defined in a very simple manner by computing the ratio between real output and labor productivity. Given a labor coefficient (b, as defined above), labor demand will move inversely with respect to labor productivity.

$$N_{A_t}^{AR} = \frac{y_{A_t}^{AR}}{a_{A_t}^{AR}} \quad (27)$$

$$N_{N_t}^{AR} = \frac{y_{N_t}^{AR}}{a_{N_t}^{AR}} \quad (28)$$

$$N_{IC_t}^{AR} = \frac{y_{IC_t}^{AR}}{a_{IC_t}^{AR}} \quad (29)$$

$$N_{A_t}^{RW} = \frac{y_{A_t}^{RW}}{a_{A_t}^{RW}} \quad (30)$$

$$N_{N_t}^{RW} = \frac{y_{N_t}^{RW}}{a_{N_t}^{RW}} \quad (31)$$

$$N_{IC_t}^{RW} = \frac{y_{IC_t}^{RW}}{a_{IC_t}^{RW}} \quad (32)$$

Labor Productivity is modeled by introducing Kaldor-Verdoorn's Law (McCombie & Thirlwall, 1994; Kaldor, 1974), which basically consists of a positive relationship between the level of activity and the level of productivity. When what is modeled is the evolution of total factor productivity it is normal to use GDP as the level of activity, which change over time impacts positively on productivity growth. However, since we are aiming at modeling labor productivity, it is reasonable to describe a positive relationship between the latter and employment.

$$a_{A_t}^{AR} = \beta_0^{AR} + \beta_1^{AR}.N_{A_t}^{AR} \quad (33)$$

$$a_{N_t}^{AR} = \beta_2^{AR} + \beta_3^{AR}.N_{N_t}^{AR} \quad (34)$$

$$a_{IC_t}^{AR} = \beta_4^{AR} + \beta_5^{AR}.N_{IC_t}^{AR} \quad (35)$$

$$a_{A_t}^{RW} = \beta_0^{RW} + \beta_1^{RW}.N_{A_t}^{RW} \quad (36)$$

$$a_{N_t}^{RW} = \beta_2^{RW} + \beta_3^{RW}.N_{N_t}^{RW} \quad (37)$$

$$a_{IC_t}^{RW} = \beta_4^{RW} + \beta_5^{RW}.N_{IC_t}^{RW} \quad (38)$$

Household's Income and Consumption

Once wages and employment have been determined, it is possible to define household's income, which in turn will be very useful to derive the consumption variables that were presented in the matrix of real transactions. In order to split before and after-tax income (being the latter the main determinant of consumption) it is worth starting by defining personal income, which is given by the sum of wage-earnings and interest payments coming from

deposits held by households in previous periods. These are the sources of income that will subsequently be levied by the government.

$$YP_t^{AR} = w_{A_t}^{AR}.N_{A_t}^{AR} + w_{N_t}^{AR}.N_{N_t}^{AR} + w_{IC_t}^{AR}.N_{IC_t}^{AR} + rd_{t-1}^{AR}.M_{t-1}^{AR} \quad (39)$$

$$YP_t^{RW} = w_{A_t}^{RW}.N_{A_t}^{RW} + w_{N_t}^{RW}.N_{N_t}^{RW} + w_{IC_t}^{RW}.N_{IC_t}^{RW} + rd_{t-1}^{RW}.M_{t-1}^{RW} \quad (40)$$

$$Th_t^{AR} = \theta_H^{AR}.YP_t^{AR} \quad (41)$$

$$Th_t^{RW} = \theta_H^{RW}.YP_t^{RW} \quad (42)$$

Variable rd on equations (39 – 40) is the interest rate that households earn on deposits held at commercial banks, and M is the stock of deposits earning the interest rate rd. As regards θ_H, it is the tax rate on personal income that households pay to the government. As it is usually defined, disposable income is given by after-tax household income. Since firms and commercial banks are owned by someone that in one way or another is part of the household sector, disposable income will also include banks' and firms' after-tax profits ($Pb\ and\ ATP$). In the specific case of the profits earned by the "N" and "A" sectors, it is assumed that a certain fraction is distributed to households and the remaining one is used as a source of financing for investment projects. As in the current setting of the model the "IC" and "Banks" sectors do not invest at all, the totality of profits are transferred to households. Moreover, households may obtain capital gains as a result of past holdings of foreign exchange (USD) every time the exchange rate depreciates (E goes up). Therefore:

$$YD_t^{AR} = (1 - \theta_H^{AR}).YP_t^{AR} + Pb_t^{AR} + ATP_{IC_t}^{AR} + div^{AR}.\left(ATP_{A_t}^{AR} + ATP_{N_t}^{AR}\right) + USD_{H_{t-1}}^{AR}.\Delta E_t \quad (43)$$

$$YD_t^{RW} = (1 - \theta_H^{RW}).YP_t^{RW} + Pb_t^{RW} + ATP_{IC_t}^{RW} + div^{RW}.\left(ATP_{A_t}^{RW} + ATP_{N_t}^{RW}\right) \quad (44)$$

Household's consumption function is a Modigliani-type function, where consumption depends on by disposable income and on the stock of wealth (Vh). If the portfolio of households is, on average, exhibiting an increase in its value (as a result of a bubble in the stock or real estate market, or any other reason than may yield a higher value of the portfolio) individuals may feel richer and this will encourage them to increase their spending. Since the portfolio of a typical Argentinean household is rather simple the wealth effect does not seem to play a very relevant role. But for completeness and also to examine what would happen if, for instance, the domestic financial market was deepened, the term corresponding to the wealth effect is written. Household's wealth is obtained through the accounting identity that states that the change in the stock of wealth is given by the flow of savings, i.e., the difference between disposable income and consumption.

$$C_t^{AR} = \alpha_1^{AR}.YD_t^{AR} + \alpha_2^{AR}.Vh_{t-1}^{AR} \tag{45}$$

$$C_t^{RW} = \alpha_1^{RW}.YD_t^{RW} + \alpha_2^{RW}.Vh_{t-1}^{RW} \tag{46}$$

$$\Delta Vh_t^{AR} = YD_t^{AR} - C_t^{AR} \tag{47}$$

$$\Delta Vh_t^{RW} = YD_t^{RW} - C_t^{RW} \tag{48}$$

Equations (45 – 46) define the flow of aggregate consumption that appears in the social accounting matrix, but they say nothing about how consumption is divided into the different goods available in the market. Therefore, it is necessary to specify how the different components of consumption that were introduced in the matrix of real transactions are obtained. Household's consumption is assumed to follow Engel's Law, which states that consumption of agricultural goods is income-inelastic and consumption of non-agricultural goods is income-elastic. Engel's Law can be expressed as follows (Taylor, 1983):

$$CoA_{AR_t}^{AR} = \alpha_3^{AR}.C_t^{AR} + \phi^{AR}.P_{A_t}^{AR} \tag{49}$$

$$CoN_{AR_t}^{AR} = (1 - \alpha_3^{AR}).d^{AR}.C_t^{AR} - \frac{\phi^{AR}}{2}.P_{A_t}^{AR} \quad (50)$$

$$CoN_{AR_t}^{RW} = C_t^{AR} - CoA_{AR_t}^{AR} - CoN_{AR_t}^{AR} \quad (51)$$

$$CoA_{RW_t}^{RW} = (1 - \alpha_3^{RW}).d_t^{RW}.C_t^{RW} + \frac{\phi^{RW}}{2}.P_{A_t}^{RW} \quad (52)$$

$$CoN_{RW_t}^{RW} = \alpha_3^{RW}.C_t^{RW} - \phi^{RW}.P_{A_t}^{RW} \quad (53)$$

$$CoA_{RW_t}^{AR} = C_t^{RW} - CoA_{RW_t}^{RW} - CoN_{RW_t}^{RW} \quad (54)$$

Equation (49) states that Argentinean households purchase a fraction $\alpha_3^{AR}$of their total consumption under the form of "A" goods. The parameter $\phi^{AR}$is introduced in order to give the consumption pattern of households a behavior that matches Engel's Law. As regards (1 - α_3^{AR}), it is the proportion of total consumption that is spent on "N" goods. As it was already mentioned, Argentinean households may purchase these goods in the domestic market and abroad. Since some of these "N" goods are non-tradable (like services) and many other do not have substitutes in the domestic market, it would not be correct to write a consumption choice of "N" goods based on the real exchange rate. Thus, the parameter d^{AR} was introduced. This parameter is stating that a fraction d^{AR} of consumption of "N" goods is filled with domestically-produced goods. As a result, the consumption of foreign goods can be computed as a residual. A similar rationale is applied when disaggregating household's consumption in the Rest of the World, but it should be noted that the meaning of α_3^{RW} is inverted and that d_t^{RW} is referring to the share of consumption of domestically-produced "A" goods out of total consumption of "A". Moreover, the parameter d_t^{RW}has become a variable since, unlike "N" goods, "A" goods are fully tradable and produced in both countries (therefore, substitution is possible). It is now correct to write a consumption decision of domestic and foreign "A" goods by the households of the rest of the world.

$$d_t^{RW} = d_1^{RW} if\ w_{A_t}^{AR}.b_A^{AR} + P_{IC_t}^{AR}.\rho^{AR}.\epsilon^{AR} + P_{IC_t}^{RW}.E_t.\rho^{AR}.(1 - \epsilon^{AR}) \leq P_{A_t}^{RW}.E_t \quad (55)$$

$$0 \quad if\ w_{A_t}^{AR}.b_A^{AR} + P_{IC_t}^{AR}.\rho^{AR}.\epsilon^{AR} + P_{IC_t}^{RW}.E_t.\rho^{AR}.(1-\epsilon^{AR}) > P_{A_t}^{RW}.E_t$$

Equation (55) states that the Rest of the World will import from Argentina a fraction d_1^{RW} ($0<d_1^{RW}<1$) of its total demand for good "A" only if production costs in Argentina are such that importing from Argentina is not more expensive than purchasing the goods at home. If for any reason (for instance, a devaluation that brings about a generalized inflation) production costs in dollars exceed the international price of good "A", then Argentina's exports drop to zero.

Note that once equations (49-54) have been defined, it is now possible to understand the forces that explain $P_{A_t}^{RW}$, as it was written in equation (17).

The last step that needs to be taken to finish the description of households is to explain how their portfolio is composed. As it can be read from the matrix of stocks, Argentinean households may choose to hold their wealth under three types of assets: pesos (ARS), dollars (USD) and bank deposits (M). Although only bank deposits yield an interest, households may want to hold some part of their wealth under the form of other assets. In the case of pesos, because households always need to have available cash in order to pay for daily purchases. In the case of dollars, because households in Argentina consider this asset as one of the most secure stores of value. Equations (56 – 58) describe the portfolio decision of households based on Tobin-Godley criteria (Tobin, 1969; Godley, 1996).

$$M_{h_t}^{AR} = Vh_t^{AR}.(\gamma_{10}^{AR} + \gamma_{11}^{AR}.rd_t^{AR} + \gamma_{12}^{AR}.\frac{\Delta E_t}{E_{t-1}} + \gamma_{13}^{AR}.\frac{\Delta C_t^{AR}}{C_{t-1}^{AR}}) \tag{56}$$

$$USD_{h_t}^{AR} = Vh_t^{AR}.(\gamma_{20}^{AR} + \gamma_{21}^{AR}.rd_t^{AR} + \gamma_{22}^{AR}.\frac{\Delta E_t}{E_{t-1}} + \gamma_{23}^{AR}.\frac{\Delta C_t^{AR}}{C_{t-1}^{AR}}) \tag{57}$$

$$ARS_{h_t}^{AR} = Vh_t^{AR} - M_{h_t}^{AR} - M_{h_t}^{AR} \tag{58}$$

These equations state that household's wealth is allocated into the three aforementioned assets. Deposits get more desired when the interest rate goes up, US dollars are more demanded when the peso is depreciating (thus, household behavior may be destabilizing in the sense that their attempt to cover from further depreciations may lead to the depreciation itself in a self-fulfilling prophecy manner) and the demand for pesos depend on the rate of growth of

consumption (since as consumption increases more liquidity is required to finance it). Note that dollars held by Argentinean households are expressed in their equivalent in pesos.

The portfolio decision of the households of the Rest of the World is simpler: they have to choose between dollar and bank deposits holdings. Their determinants are consumption growth and the interest rate. This portfolio decision is also written according to Tobin-Godley criteria.

$$USD_{h_t}^{RW} = Vh_t^{RW}.(\gamma_{10}^{RW} + \gamma_{11}^{RW}.\frac{\Delta C_t^{RW}}{C_{t-1}^{RW}} + \gamma_{12}^{RW}.rd_t^{RW}) \quad (59)$$

$$M_{h_t}^{RW} = Vh_t^{RW} - USD_{h_t}^{RW} \quad (60)$$

Intermediate Goods

We assume that there is a fixed proportion of intermediate goods that is required to undertake the production process. We denote this proportion ρ^{AR} and it can be used to derive the real demand for intermediate goods by each sector.

$$ica_t^{AR} = \rho^{AR}.y_{A_t}^{AR} \quad (61)$$

$$icn_t^{AR} = \rho^{AR}.y_{N_t}^{AR} \quad (62)$$

$$ica_t^{RW} = \rho^{RW}.y_{A_t}^{RW} \quad (63)$$

$$icn_t^{RW} = \rho^{RW}.y_{N_t}^{RW} \quad (64)$$

In order to obtain the nominal demand of intermediate goods (which is the variable that was presented in the matrix of real transactions) it is necessary to multiply the real demands by

the corresponding price index. Recall that $\epsilon^{AR}$is the share of domestic intermediate goods out of total demand for intermediate goods by sectors "A" and "N".

$$ICA_{AR_t}^{AR} = ica_t^{AR}.\epsilon^{AR}.P_{IC_t}^{AR} \quad (65)$$

$$ICA_{AR_t}^{RW} = ica_t^{AR}.(1 - \epsilon^{AR}).P_{IC_t}^{RW}.E_t \quad (66)$$

$$ICN_{AR_t}^{AR} = icn_t^{AR}.\epsilon^{AR}.P_{IC_t}^{AR} \quad (67)$$

$$ICN_{AR_t}^{RW} = icn_t^{AR}.(1 - \epsilon^{AR}).P_{IC_t}^{RW}.E_t \quad (68)$$

$$ICA_{RW_t}^{RW} = ica_t^{RW}.P_{IC_t}^{RW} \quad (69)$$

$$ICN_{RW_t}^{RW} = icn_t^{RW}.P_{IC_t}^{RW} \quad (70)$$

Investment, Loans and Capital Accumulation

One important feature of a developing country that should be taken into account by a structuralist model is credit rationing. Although this is not a regular fact among developing countries, it is reasonable to think that Argentinean entrepreneurs do not have access to as much credit as it would be necessary to finance their investment projects. The result of such a situation could be that not all the desired amount of investment is undertaken - that may have negative consequences both on the current and the future rate of growth of the economy. In this model it is assumed that whereas credit rationing occurs in Argentina, the Rest of the World grants loans on demand to all the credit-worthy entrepreneurs.

We will then start by defining a flow of desired investment by the Argentinean firms. Following the Keynesian and Kaleckian literature, it is assumed that investment is driven by current after-tax profit rate (ATP), the ratio of interest payments to the capital stock, capacity

utilization (u) and on firms' wealth (Vf)[3]. Note that capacity utilization will only be considered in the desired-investment function of the "N" sector since, as it was mentioned above, capacity utilization in sector "A" is always equal to one.

$$\frac{Id_{A_t}^{AR}}{K_{A_{t-1}}^{AR}} = z_0^{AR} + z_1^{AR}.\frac{ATP_{A_t}^{AR}}{K_{A_{t-1}}^{AR}} - z_2^{AR}.\frac{rl_{t-1}^{AR}.L_{A_{t-1}}^{AR}}{K_{A_{t-1}}^{AR}} + z_4^{AR}.\frac{Vf_{A_{t-1}}^{AR}}{K_{A_{t-1}}^{AR}}$$

(71)

$$\frac{Id_{N_t}^{AR}}{K_{N_{t-1}}^{AR}} = z_0^{AR} + z_1^{AR}.\frac{ATP_{N_t}^{AR}}{K_{N_{t-1}}^{AR}} - z_2^{AR}.\frac{rl_{t-1}^{AR}.L_{N_{t-1}}^{AR}}{K_{N_{t-1}}^{AR}} + z_3^{AR}.u_{N_{t-1}}^{AR} + z_4^{AR}.\frac{Vf_{N_{t-1}}^{AR}}{K_{N_{t-1}}^{AR}}$$

(72)

Since there is credit rationing in Argentina, not all the flow of desired-investment will be financed. Thus, the functions of effective nominal investment are the following:

$$I_{A_t}^{AR} = Id_{A_t}^{AR} \qquad if\ Id_{A_t}^{AR} \leq \Delta Ls_{A_t}^{AR} + (1 - div^{AR}).ATP_{A_t}^{AR} \quad (73)$$

$$\Delta Ls_{A_t}^{AR} + (1 - div^{AR}).ATP_{A_t}^{AR} \qquad if\ Id_{A_t}^{AR} > \Delta Ls_{A_t}^{AR} + (1 - div^{AR}).ATP_{A_t}^{AR}$$

$$I_{N_t}^{AR} = Id_{N_t}^{AR} \qquad if\ Id_{N_t}^{AR} \leq \Delta Ls_{N_t}^{AR} + (1 - div^{AR}).ATP_{N_t}^{AR} \quad (74)$$

$$\Delta Ls_{N_t}^{AR} + (1 - div^{AR}).ATP_{N_t}^{AR} \qquad if\ Id_{N_t}^{AR} > \Delta Ls_{N_t}^{AR} + (1 - div^{AR}).ATP_{N_t}^{AR}$$

$$\frac{Id_{A_t}^{RW}}{K_{A_{t-1}}^{RW}} = z_0^{RW} + z_1^{RW}.\frac{ATP_{A_t}^{RW}}{K_{A_{t-1}}^{RW}} - z_2^{RW}.\frac{rl_{t-1}^{RW}.L_{A_{t-1}}^{RW}}{K_{A_{t-1}}^{RW}} + z_4^{RW}.\frac{Vf_{A_{t-1}}^{RW}}{K_{A_{t-1}}^{RW}}$$

(75)

$$\frac{Id_{N_t}^{RW}}{K_{N_{t-1}}^{RW}} = z_0^{RW} + z_1^{RW}.\frac{ATP_{N_t}^{RW}}{K_{N_{t-1}}^{RW}} - z_2^{RW}.\frac{rl_{t-1}^{RW}.L_{N_{t-1}}^{RW}}{K_{N_{t-1}}^{RW}} + z_3^{RW}.u_{N_{t-1}}^{RW} + z_4^{RW}.\frac{Vf_{N_{t-1}}^{RW}}{K_{N_{t-1}}^{RW}}$$

(76)

Equations (73 – 74) state that if desired investment is smaller or equal to the available sources of finance (credit supply plus after-tax profits), then effective investment is equal to

[3] This is a very similar investment function to the one presented by Fazzari & Mott (Fazzari & Mott, 1986-1987), which they label as a Kalecki-Steindl-Keynes-Minsky investment function.

desired investment. However, investment is constrained if the sources of finance are not enough to fund the desired flow of investment. As regards equations (75 – 76), they are exactly equal to equations (71 – 72) that were written for Argentina - the only difference is that since there are no credit constraints in the Rest of the World effective investment is always equal to desired investment.

Once the nominal flows of investment were obtained for each of the sectors it is necessary to describe the real flows of investment, which in turn will make us encounter another structural feature of the Argentinean economy that needs to be taken into account. Since the flow of investment in Argentina is composed by both domestic and foreign capital goods, it is required that we define what the relationship between these acquisitions of capital goods is. Phrased differently, the decision on how many imported capital goods are brought to the country is not random, but it follows from the structure of the production side. In order to keep things simple, it seems reasonable to assume that both, sectors "A" and "N" operate with the so-called Leontief technology, which implies that domestic and foreign capital goods complement each other in the production process. Therefore, for every unit of domestic capital goods that is acquired, a certain amount of capital goods need to be brought from abroad 8in this case it is assumed a one-to-one relationship). Otherwise, the newly purchased domestic capital goods cannot be used in the production process. If this is the technological setting that we have in mind, the real flow of investment of each of the sectors can be written as follows:

$$ia_{AR_t}^{AR} = \frac{I_{A_t}^{AR}}{P_{N_t}^{AR} + P_{N_t}^{RW} \cdot E_t} \tag{77}$$

$$ia_{AR_t}^{RW} = \frac{I_{A_t}^{AR}}{P_{N_t}^{AR} + P_{N_t}^{RW} \cdot E_t} \tag{78}$$

$$in_{AR_t}^{AR} = \frac{I_{N_t}^{AR}}{P_{N_t}^{AR} + P_{N_t}^{RW} \cdot E_t} \tag{79}$$

$$in_{AR_t}^{AR} = \frac{I_{N_t}^{AR}}{P_{N_t}^{AR} + P_{N_t}^{RW} \cdot E_t} \tag{80}$$

The real flow of investment of sectors "A" and "N" of the rest of the world is much simpler since there are no foreign capital goods taking part of the investment decision.

$$ia_{RW_t}^{RW} = \frac{I_{A_t}^{RW}}{P_{N_t}^{RW}} \quad (81)$$

$$in_{RW_t}^{RW} = \frac{I_{N_t}^{RW}}{P_{N_t}^{RW}} \quad (82)$$

We can now go back to nominal terms to obtain the nominal flow of investment by each of the sectors of the two countries that appeared in the matrix of real transactions. For completeness, we also write the aggregate flow of investment.

$$IA_{AR_t}^{AR} = ia_{AR_t}^{AR}.P_{N_t}^{AR} \quad (83)$$

$$IA_{AR_t}^{RW} = ia_{AR_t}^{RW}.P_{N_t}^{RW}.E_t \quad (84)$$

$$IN_{AR_t}^{AR} = in_{AR_t}^{AR}.P_{N_t}^{AR} \quad (85)$$

$$IN_{AR_t}^{RW} = in_{AR_t}^{RW}.P_{N_t}^{RW}.E_t \quad (86)$$

$$IA_{RW_t}^{RW} = ia_{RW_t}^{RW}.P_{N_t}^{RW} \quad (87)$$

$$IN_{RW_t}^{RW} = in_{RW_t}^{RW}.P_{N_t}^{RW} \quad (88)$$

$$I_t^{AR} = IA_{AR_t}^{AR} + IA_{AR_t}^{RW} + IN_{AR_t}^{AR} + IN_{AR_t}^{RW} \quad (89)$$

$$I_t^{RW} = IA_{RW_t}^{RW} + IN_{RW_t}^{RW} \quad (90)$$

Once all the relevant flows of investment have been defined, it is possible to describe the capital accumulation process. In the case of Argentina, as it has already been pointed out, the aggregate stock of capital is composed of domestic and foreign goods. Thus, these two accumulation processes will be defined separately. The situation will be simpler for the Rest of the World. In any case, the real stock of capital at any point of time is given by the stock on the previous period net of its depreciation plus the current flow of real investment. In order to get the capital stock in nominal terms, we can then multiply each measure of real capital by the corresponding price index.

$$ka_{AR_t}^{AR} = (1 - \delta^{AR}).ka_{AR_{t-1}}^{AR} + ia_{AR_t}^{AR} \quad (91)$$

$$ka_{AR_t}^{RW} = (1 - \delta^{AR}).ka_{AR_{t-1}}^{RW} + ia_{AR_t}^{RW} \quad (92)$$

$$kn_{AR_t}^{AR} = (1 - \delta^{AR}).kn_{AR_{t-1}}^{AR} + in_{AR_t}^{AR} \quad (93)$$

$$kn_{AR_t}^{RW} = (1 - \delta^{AR}).kn_{AR_{t-1}}^{RW} + in_{AR_t}^{RW} \quad (94)$$

$$ka_{RW_t}^{RW} = (1 - \delta^{RW}).ka_{RW_{t-1}}^{RW} + ia_{RW_t}^{RW} \quad (95)$$

$$kn_{RW_t}^{RW} = (1 - \delta^{RW}).ka_{RW_{t-1}}^{RW} + in_{RW_t}^{RW} \quad (96)$$

$$K_{A_t}^{AR} = ka_{AR_t}^{AR}.P_{N_t}^{AR} + ka_{AR_t}^{RW}.P_{N_t}^{RW}.E_t \quad (97)$$

$$K_{N_t}^{AR} = kn_{AR_t}^{AR}.P_{N_t}^{AR} + kn_{AR_t}^{RW}.P_{N_t}^{RW}.E_t \quad (98)$$

$$K_{A_t}^{RW} = ka_{RW_t}^{RW}.P_{N_t}^{RW} \quad (99)$$

$$K_{N_t}^{RW} = kn_{RW_t}^{RW}.P_{N_t}^{RW} \quad (100)$$

Another variable that still needs to be defined is credit supply, which played a very important role in the determination of investment[4]. In the case of the Rest of the World credit is supplied on demand, i.e., commercial banks grant as many loans as firms desire. However, in the case of Argentina it is necessary to write a behavioral equation describing how much credit banks are willing to supply. Afterwards, the effective amount of credit that is granted will depend on the relationship between credit supply and demand, as it can be deduced from equation (73 – 74). Credit supplied by commercial banks of Argentina is assumed to depend positively on firms' wealth – as firms get richer they become more creditworthy thereby encouraging the banks to give them more sources of financing.

$$\Delta Ls_{A_t}^{AR} = \psi_0^{AR} + \psi_1^{AR}.\Delta Vf_{A_t}^{AR} \quad (101)$$

$$\Delta Ls_{N_t}^{AR} = \psi_0^{AR} + \psi_1^{AR}.\Delta Vf_{N_t}^{AR} \quad (102)$$

Equations (101 – 102) yield the input for equations (73 – 74) which, in turn, determine the investment flow of Argentina. It is then possible to compute the actual flow of credit for each of the sectors of each country.

$$\Delta L_{A_t}^{AR} = IA_{AR_t}^{AR} + IA_{AR_t}^{RW} - (1 - div^{AR}).ATP_{A_t}^{AR} \quad (103)$$

$$\Delta L_{N_t}^{AR} = IN_{AR_t}^{AR} + IN_{AR_t}^{RW} - (1 - div^{AR}).ATP_{N_t}^{AR} \quad (104)$$

[4] The way in which credit rationing is introduced in this model is rather simple. For a more accurate description of this process, see Le Heron, 2012.

$$\Delta L_{A_t}^{RW} = IA_{RW_t}^{RW} - (1 - div^{RW}).ATP_{A_t}^{RW} \quad (105)$$

$$\Delta L_{N_t}^{RW} = IN_{RW_t}^{RW} - (1 - div^{RW}).ATP_{N_t}^{RW} \quad (106)$$

$$\Delta L_t^{AR} = \Delta L_{A_t}^{AR} + \Delta L_{N_t}^{AR} \quad (107)$$

$$\Delta L_t^{RW} = \Delta L_{A_t}^{RW} + \Delta L_{N_t}^{RW} \quad (108)$$

We now need to define other variables that appeared in the investment function, namely capacity utilization, after-tax profits and firms' wealth. Let us start by capacity utilization, which is usually written as follows:

$$u_{N_t}^{AR} = \frac{y_{N_t}^{AR}}{k_{N_t}^{AR}}.\xi^{AR} \quad (109)$$

$$u_{N_t}^{RW} = \frac{y_{N_t}^{RW}}{k_{N_t}^{RW}}.\xi^{RW} \quad (110)$$

The coefficient ξ in equations (109 – 110) is the long-term capital-output ratio. As regards firms' wealth, it can be computed as the difference between firms' sole asset (capital) and liabilities (loans).

$$Vf_{A_t}^{AR} = K_{A_t}^{AR} - L_{A_t}^{AR} \quad (111)$$

$$Vf_{N_t}^{AR} = K_{N_t}^{AR} - L_{N_t}^{AR} \quad (112)$$

$$Vf_{A_t}^{RW} = K_{A_t}^{RW} - L_{A_t}^{RW} \quad (113)$$

$$Vf_{N_t}^{RW} = K_{N_t}^{RW} - L_{N_t}^{RW} \quad (114)$$

In order to compute after-tax profits it is first necessary to define gross profits, which result from the difference between sales and production costs (both labor and intermediate goods costs) minus interest payments.

$$Pf_{A_t}^{AR} = Y_{A_t}^{AR} - w_{A_t}^{AR}.N_{A_t}^{AR} - ICA_{AR_t}^{AR} - ICA_{AR_t}^{RW} - rl_{t-1}^{AR}.L_{A_{t-1}}^{AR}$$

(115)

$$Pf_{N_t}^{AR} = Y_{N_t}^{AR} - w_{N_t}^{AR}.N_{N_t}^{AR} - ICN_{AR_t}^{AR} - ICN_{AR_t}^{RW} - rl_{t-1}^{AR}.L_{N_{t-1}}^{AR}$$

(116)

$$Pf_{IC_t}^{AR} = Y_{IC_t}^{AR} - w_{IC_t}^{AR}.N_{IC_t}^{AR} \quad (117)$$

$$Pf_{A_t}^{RW} = Y_{A_t}^{RW} - w_{A_t}^{RW}.N_{A_t}^{RW} - ICA_{RW_t}^{RW} - rl_{t-1}^{RW}.L_{A_{t-1}}^{RW}$$

(118)

$$Pf_{N_t}^{RW} = Y_{N_t}^{RW} - w_{N_t}^{RW}.N_{N_t}^{RW} - ICN_{RW_t}^{RW} - rl_{t-1}^{RW}.L_{N_{t-1}}^{RW} \quad (119)$$

$$Pf_{IC_t}^{RW} = Y_{IC_t}^{RW} - w_{IC_t}^{RW}.N_{IC_t}^{RW}$$

(120)

The government levies a tax (θ_F) on gross profits and, in the case of the "A" sector in Argentina, it may also collect an additional tax corresponding to the export duty (σ^{AR}). If we deduct taxes on firms from gross profits we get after-tax profits (ATP).

$$Tf_{A_t}^{AR} = \theta_F^{AR}.Pf_{A_t}^{AR} + \sigma^{AR}.CoA_{RW_t}^{AR}.E_t$$

(121)

$$Tf_{N_t}^{AR} = \theta_F^{AR}.Pf_{N_t}^{AR} \quad (122)$$

$$Tf_{IC_t}^{AR} = \theta_F^{AR}.Pf_{IC_t}^{AR} \quad (123)$$

$$Tf_{A_t}^{RW} = \theta_F^{RW}.Pf_{A_t}^{RW} \quad (124)$$

$$Tf_{N_t}^{RW} = \theta_F^{RW}.Pf_{N_t}^{RW} \quad (125)$$

$$Tf_{IC_t}^{RW} = \theta_F^{RW}.Pf_{IC_t}^{RW} \quad (126)$$

$$ATP_{A_t}^{AR} = Pf_{A_t}^{AR} - Tf_{A_t}^{AR} \quad (127)$$

$$ATP_{N_t}^{AR} = Pf_{N_t}^{AR} - Tf_{N_t}^{AR} \quad (128)$$

$$ATP_{IC_t}^{AR} = Pf_{IC_t}^{AR} - Tf_{IC_t}^{AR} \quad (129)$$

$$ATP_{A_t}^{RW} = Pf_{A_t}^{RW} - Tf_{A_t}^{RW} \quad (130)$$

$$ATP_{N_t}^{RW} = Pf_{N_t}^{RW} - Tf_{N_t}^{RW} \quad (131)$$

$$ATP_{IC_t}^{RW} = Pf_{IC_t}^{RW} - Tf_{IC_t}^{RW} \quad (132)$$

Government

Thus far, all the components of aggregate demand have been defined except for government expenditure. In this model it is assumed that government expenditure is exogenous and growing at a constant rate. However, the equation corresponding to purchases of domestic "A" goods by the government of Argentina are written as a residual. The reason for this is that we need to ensure that the domestic market for "A" is in equilibrium and since the price is determined exogenously in the international market and production is given in every period, the adjustment needs to be made in the demand side (i.e., some sector should be buying an amount of "A" goods that differs from the desired amount). The simplest way to

introduce this adjustment in the demand side is to let the government clear this market. However, a more elegant closure could be though out.

$$GoA_{AR_t}^{AR} = Y_{A_t}^{AR} - CoA_{AR_t}^{AR} - CoA_{RW_t}^{AR} \quad (133)$$

$$GoN_{AR_t}^{AR} = g_{N_t}^{AR} + \left(1 + \lambda_N^{AR}\right).GoN_{AR_{t-1}}^{AR} \quad (134)$$

$$GoA_{RW_t}^{RW} = g_{A_t}^{RW} + \left(1 + \lambda_A^{RW}\right).GoA_{RW_{t-1}}^{RW} \quad (135)$$

$$GoN_{RW_t}^{RW} = g_{N_t}^{RW} + (1 + \lambda_N^{RW}).GoN_{RW_{t-1}}^{RW} \quad (136)$$

$$G_t^{AR} = GoA_{AR_t}^{AR} + GoN_{AR_t}^{AR} \quad (137)$$

$$G_t^{RW} = GoA_{RW_t}^{RW} + GoN_{RW_t}^{RW} \quad (138)$$

Total tax collection is given by the sum of taxes levied on households and firms.

$$T_t^{AR} = Th_t^{AR} + Tf_{A_t}^{AR} + Tf_{N_t}^{AR} + Tf_{IC_t}^{AR} \quad (139)$$

$$T_t^{RW} = Th_t^{RW} + Tf_{A_t}^{RW} + Tf_{N_t}^{RW} + Tf_{IC_t}^{RW} \quad (140)$$

The government issues bonds in order to cover the financing needs. Although the government of the Rest of the World issues bonds that are denominated in US dollars, the government of Argentina does not hold the same privilege, i.e., the possibility of having its liabilities denominated in the currency that it issues. This is a very important feature of a developing economy like Argentina and is connected to many of the balance of payments problems that Latin America faced during the last century. Thus, the Argentinean government will be allowed to issue debt under the form of both peso and dollar denominated bonds. The share of the debt that is held under each type of bond will depend on the desire of the banks of the Rest of the World to have an important proportion of their wealth under the form of bonds

denominated in pesos. In order to persuade these international traders to behave this way, the Argentinean government would usually need to pay a higher interest rate.

$$\Delta B_{s_t}^{AR} = G_t^{AR} - T_t^{AR} + r_{t-1}^{AR}.B_{s,p_{t-1}}^{AR} + r_{t-1}^{RW}.B_{s,d_{t-1}}^{AR} - Pcb_t^{AR} \quad (141)$$

$$B_{s,p_t}^{AR} = B_{s_t}^{AR} - B_{s,d_t}^{AR} \quad (142)$$

$$\Delta B_{s,d_t}^{RW} = G_t^{RW} - T_t^{RW} + r_{t-1}^{RW}.B_{s,d_{t-1}}^{RW} - Pcb_t^{RW} \quad (143)$$

Equations (141 and 143) describe the change in government debt as the gap between all the sources of income and expenditures. Note that we are assuming that the central bank transfers the totality of its profits to the government. Equation (142) defines the supply of bonds denominated in pesos as a residual between the total debt of the Argentinean government and the part of the debt that banks of the Rest of the World are holding in dollars.

Commercial Banks

As it can be read from the social accounting matrix, commercial banks play an important role in the economy since they are connected to all the other sectors of the economy. In a world with increasing financilization banks may play an autonomous role that may be highly destabilizing. Although this is a very interesting feature that a model aimed at understanding the functioning of the world economy should incorporate[5], in this case we will describe banks as relatively passive actors in the sense that they do not engage in any securitization or subprime-lending process. What could happen, on the other hand, is a Minsky-type crisis since the possibility of a sudden increase in the interest rate that changes the debt structure in the economy is not ruled out. This sketching of the banking sector seems to be rather accurate as a description of Argentinean banks. A later version of the model should include financilization in the Rest of the World.

The loan and deposit-creation processes have already been defined above in equations (107 – 108), (56) and (60). It is now the time to describe the portfolio decision of commercial banks. Argentinean banks receive deposits from households and have to hold a certain amount of them as reserves at the central banks (R). The difference between deposits and reserves are the available resources that banks can allocate into different interest-bearing assets: bonds in

[5] Those interested in state-of-the-art modeling of financialization within a SFC framework can read Mazier & Saadaoui, 2012.

pesos and bonds in dollars. Thus, their portfolio decision is rather simple and follows Tobin-Godley conditions.

$$Bb_{d,d_t}^{AR} = \left(M_{b_t}^{AR} - R_t^{AR}\right).\left(\tau_{10}^{AR} + \tau_{11}^{AR}.r_t^{RW} + \tau_{12}^{AR}.r_t^{AR}\right) \quad (144)$$

$$Bb_{d,p_t}^{AR} = \left(M_{b_t}^{AR} - R_t^{AR}\right) - Bb_{d,d_t}^{AR} \quad (145)$$

Equation (144) states that the demand for dollar-denominated bonds by Argentinean commercial banks is driven by the interest rate of the Rest of the World. Equation (145) is written as a residual. In the case of the portfolio decision of the banks of the Rest of the World the situation is a little bit more complex since they can hold three types of assets: bonds issued by the government of the Rest of the World (denominated in dollars), bonds issued by the government of Argentina denominated in dollars and bonds issued by the government of Argentina denominated in pesos. This decision is very important since it determines the composition of Argentina's government debt. The higher the demand for bonds denominated in pesos, the safer the position of Argentina and the lower the external constraint.

$$Bb_{d,d_t}^{RW} = \left(M_{b_t}^{RW} - R_t^{RW}\right).\left(\tau_{10}^{RW} + \tau_{11}^{RW}.r_t^{RW} + \tau_{12}^{RW}.\left(r_t^{AR} + \frac{\Delta E_t}{E_t}\right) + \tau_{13}^{RW}.r_t^{RW}\right) \quad (146)$$

$$Bb_{d,p_t}^{RW} = \left(M_{b_t}^{RW} - R_t^{RW}\right).\left(\tau_{20}^{RW} + \tau_{21}^{RW}.r_t^{RW} + \tau_{22}^{RW}.r_t^{AR} + \tau_{23}^{RW}.\left(r_t^{RW} + \frac{\Delta E_t}{E_t}\right)\right) \quad (147)$$

$$Bb_{d,d_t}^{RW/AR} = \left(M_{b_t}^{RW} - R_t^{RW}\right) - Bb_{d,d_t}^{RW} - Bb_{d,p_t}^{RW} \quad (148)$$

Although the supply of bonds has already been defined in the section corresponding to the government, now that we know the individual demands for bonds it is necessary to write their equivalents in the supply side. This is going to be useful when writing the closure of the model.

$$Bb_{s,d_t}^{AR} = \frac{Bb_{d,d_t}^{AR}}{E_t} \quad (149)$$

$$Bb_{s,p_t}^{AR} = Bb_{d,p_t}^{AR} \quad (150)$$

$$Bb_{s,d_t}^{RW} = Bb_{d,d_t}^{RW} \quad (151)$$

$$Bb_{s,p_{t-1}}^{RW} = Bb_{d,p_t}^{RW}.E_t \quad (152)$$

$$Bb_{s,d_{t-1}}^{RW/AR} = Bb_{d,d_t}^{RW/AR}.E_t \quad (153)$$

Banks hold a ratio κ of deposits as reserves at the central bank and demand advances from the central bank in order to cover any gap in their balance sheet. In equation (156 – 157) we denote Vb the wealth of commercial banks.

$$R_t^{AR} = \kappa^{AR}.M_t^{AR} \quad (154)$$

$$R_t^{RW} = \kappa^{RW}.M_t^{RW} \quad (155)$$

$$A_t^{AR} = Bb_{d,d_t}^{AR} + Bb_{d,p_t}^{AR} + L_t^{AR} + R_t^{AR} - M_t^{AR} - Vb_t^{AR} \quad (156)$$

$$A_t^{RW} = Bb_{d,d_t}^{RW} + Bb_{d,p_t}^{RW} + Bb_{d,d_t}^{RW/AR} + L_t^{RW} + R_t^{RW} - M_t^{RW} - Vb_t^{RW} \quad (157)$$

Since, at was explained above, commercial banks transfer all their profits to households, the wealth of the former is constant. If we assume that commercial banks start with a net worth that is equal to zero, then this position will be kept over time. The only remaining variable that has to be defined in order to finish the description of commercial banks is their profits.

$$Pb_t^{AR} = r_{t-1}^{RW}.Bb_{s,d_{t-1}}^{AR}.E_t + r_{t-1}^{AR}.Bb_{s,p_{t-1}}^{AR} + rs_{t-1}^{AR}.R_{t-1}^{AR} + rl_{t-1}^{AR}.L_{t-1}^{AR} + Bb_{s,d_{t-1}}^{AR}.\Delta E_t - rd_{t-1}^{AR}.M_{t-1}^{AR} - r_{t-1}^{AR}.A_{t-1}^{AR} \quad (158)$$

$$Pb_t^{RW} = r_{t-1}^{RW}.Bb_{s,d_{t-1}}^{RW} + r_{t-1}^{AR}.Bb_{s,p_{t-1}}^{RW}.\frac{1}{E_t} + r_{t-1}^{AR}.Bb_{s,d_{t-1}}^{RW/AR}.\frac{1}{E_t} + rs_{t-1}^{RW}.R_{t-1}^{RW} + rl_{t-1}^{RW}.L_{t-1}^{RW} + Bb_{s,p_{t-1}}^{RW}.\Delta\frac{1}{E_t} - rd_{t-1}^{RW}.M_{t-1}^{RW} - r_{t-1}^{RW}.A_{t-1}^{RW} \quad (159)$$

In order to be sure that the notation is understood, let us describe term by term the components of banks' profits. The first term of equation (158) corresponds to the interest payments that Argentinean banks earn on dollar-denominated bonds. The nominal exchange rate is included in order to ensure currency consistency. The second term refers to interest earnings on bonds denominated in pesos. The third, fourth, sixth and seventh terms are just interest earnings and payments on banks' assets and liabilities that have already been defined above. Finally, the fifth term computes the profits derived from valuation effects as a result of the depreciation of the peso. A very similar reasoning should be applied when interpreting equation (159), where the first term corresponds to interest payments derived from dollar-denominated bond holdings, the second and third terms refer to interests on Argentinean bonds (both in pesos and dollars) and the sixth term computes the valuation effect.

Central Bank

Since we have already defined the majority of the sectors comprised in the model, many of the processes involving the central bank are already written. Thus, when describing the behavior of the central bank we will also be defining the closure of the model. Let us start with the central bank of Argentina. As it can be read from the matrix of stocks, the central bank of Argentina can hold Argentinean bonds as one of its assets. Following the Post Keynesian literature that stresses that interest rate are exogenous and money is endogenous, we will define the central bank's demand for domestic bonds as a residual aimed at ensuring the equilibrium in the bond market. Otherwise, interest rates would move away from the exogenous target set by the central bank[6].

$$Bcb_{d,p_t}^{AR} = B_{s,p_t}^{AR} - Bb_{s,p_t}^{AR} \quad (160)$$

The other important asset that the central bank of Argentina holds is the foreign reserves, which are held under the form of dollars[7]. The reason for this is that if Argentinean

[6] Actually, the money market of Argentina is quite different from that of Developed Economies. The description of the money market that it is made in this working paper does not consider some of the specificities of the money market of Argentina. This is one of the features that needs to be developed in further refinements of this model.

[7] Although in reality central Banks may hold their foreign reserves under the form of dollar (or other strong currency) denominated bonds. The reader interested on reserve diversification within a SFC framework can read Lavoie & Zaho, 2009.

households and the central bank are holding the same asset as a store of value (US dollars) very interesting interactions that are common in Argentina can be modeled. For instance, if the central bank is pursuing a fixed exchange rate regime (as it is assumed in this model) and households suddenly start increasing their demand for dollars, then the central bank should start selling part of its holdings of dollars in order to defend the peg. Since the total supply of dollars to Argentina by the central bank of the Rest of the World is exogenous to Argentinean households and central bank (since it is given by the current account balance), conflict between them may arise if aggregate demand for dollars exceed the value of the current account surplus. This problem will be even more severe if the current account is in deficit. In any case, as it is shown in the matrix of flows, the stock of dollars held by the central bank of Argentina is given by:

$$\Delta USD^{AR}_{s,cb_t} = \frac{\Delta ARS^{AR}_{h_t} + \Delta R^{AR}_t - \Delta Bcb^{AR}_{d,p_t} - \Delta A^{AR}_t}{E_t} \quad (161)$$

$$\Delta USD^{AR}_{cb_t} = \Delta USD^{AR}_{s,cb_t}.E_t + USD^{AR}_{s,cb_{t-1}}.\Delta E_t \quad (162)$$

Equation (161) defines the change in the stock of dollars held by the central bank of Argentina that ensures the equilibrium in the balance sheet of the monetary authority, but it is expressed in dollars. In order to obtain the equivalent in pesos we need equation (162), that accounts not only for the change in the stock but also for the valuation effect.

Regarding the behavior of the central bank of the Rest of the World, its demand for domestic bonds is also going to be written as a residual aimed at clearing the bond market. The reasons for this are exactly the same that were posed in the case of Argentina.

$$Bcb^{RW}_{d,d_t} = B^{RW}_{s,d_t} - Bb^{RW}_{s,d_t} - Bb^{AR}_{s,d_t} \quad (163)$$

One of the main liabilities of the central bank of the Rest of the World is the US dollar. Given the current setting of the model there are three sectors that hold dollars in their portfolio: households of both countries and the central bank of Argentina. In a context of endogenous money as it is the one that we observe in the US, the central bank of the rest of the world supplies as much cash as it is demanded.

$$USD_{s_t}^{RW} = USD_h^{RW} + USD_{s,cb_t}^{AR} + USD_{s,h_t}^{AR} \quad (164)$$

$$USD_{s,h_t}^{AR} = \frac{USD_h^{AR}}{E_t} \quad (165)$$

Finally, it is necessary to verify that the balance sheet of the central bank of the Rest of the World is in equilibrium (i.e., that the change in total assets equals the sum of the change in total liabilities and the change in net worth). However, if we take a look at the matrix of flows, we see that there are no variables left to be defined. In other words, we cannot use US dollars to ensure the equilibrium in the central bank of the Rest of the World since, as it was mentioned above, the supply of dollars is endogenous. Nevertheless, if our model is consistent it should happen that the following equation holds at every point of time. This equation is not written when running the model (otherwise, the model would be overdetermined) but is used to check the consistency of the model.

$$\Delta USD_{s_t}^{RW} = \Delta A_t^{RW} + \Delta Bcb_{d,d_t}^{RW} - \Delta R_t^{RW} \quad (166)$$

Finally, it is assumed that all the interest rates in the economy are exogenous. This is clearly not how things happen in the real world, but given that this is a first version of the SPKSFC model, before building an even more complex model it is desirable to understand all the mechanisms that are working under the current setting. If interest rates were desired to be endogenous, Taylor-rules may be introduced in order to account for the various policy objectives that the central bank may pursue.

$$rd_t^{AR} = rl_t^{AR} = rs_t^{AR} = r_t^{AR} = \bar{r}^{AR} \quad (167 - 170)$$

$$rd_t^{RW} = rl_t^{RW} = rs_t^{RW} = r_t^{RW} = \bar{r}^{RW} \quad (171 - 174)$$

International Trade and Exchange Rate

The demand for foreign goods by each country has already been defined in the sections concerning investment and consumption of final and intermediate goods. We can now sum this up in order to obtain aggregate exports and imports.

$$IM_t^{RW} = CoA_{RW_t}^{AR} \tag{175}$$

$$X_t^{AR} = IM_t^{RW}.E_t \tag{176}$$

$$IM_t^{AR} = CoN_{AR_t}^{RW} + IA_{AR_t}^{RW} + IN_{AR_t}^{RW} + ICA_{AR_t}^{RW} + ICN_{AR_t}^{RW} \tag{177}$$

$$X_t^{RW} = \frac{IM_t^{AR}}{E_t} \tag{178}$$

Regarding the nominal exchange rate, in this first version of the model it will be assumed to behave in such a way that the central bank holds at least a certain amount of US dollars as foreign reserves. Therefore, the nominal exchange rate will be fixed as long as the central bank can hold a stock of dollars that is equal or larger than target reserves (usually, the value equal to three months of imports plus short-term interest payments – this is the target that we adopt in this model but it could be any reasonable rule stating a desired stock of foreign reserves). If at a certain point of time the current account starts to deteriorate in such a way that the central bank has to start selling dollars in order to defend the peg, then a devaluation will have to take place (considering that the authorities are not willing to slow down the economy). In this model we assume that every time reserves are about to fall below the targeted threshold, the peso is allowed to depreciate 5%. In a future refinement of the model an exchange rate rule that endogeneizes the exchange rate to a certain target of the current account could be introduced.

$$\begin{aligned} E_t &= E_{t-1} \qquad if\ USD_{cb}^{AR} \geq USD_{cb}^{AR} \\ & E_{t-1}.1{,}05\ if\ USD_{cb}^{AR} < USD_{cb}^{AR} \end{aligned} \tag{179}$$

The balancing entry of a fixed exchange rate should be a change in the stock of foreign reserves of the central bank. This process has already been defined in equation (161 - 162). The model has now been entirely closed.

Balance of Payments

Once the model has been closed, some well-known accounting identities can be written in order to check that the model is fully consistent (although this should already be guaranteed by the fulfillment of equation (166)). One of these accounting identities states that the sum of

the current account and the capital account should be equal to zero. In order to do so, it is first necessary to write the equations corresponding to both the current and the capital accounts, which will in turn be useful since the current account balance is one of the mostly used indicators to monitor macroeconomic performance.

$$CA_t^{AR} = X_t^{AR} - IM_t^{AR} + r_{t-1}^{RW}.Bb_{s,d_{t-1}}^{AR}.E_t - r_{t-1}^{AR}.Bb_{s,d_{t-1}}^{RW} - r_{t-1}^{AR}.Bb_{s,p_{t-1}}^{RW} \quad (180)$$

$$CA_t^{RW} = X_t^{RW} - IM_t^{RW} + r_{t-1}^{AR}.Bb_{s,d_{t-1}}^{RW/AR}.\frac{1}{E_t} + r_{t-1}^{AR}.Bb_{s,p_{t-1}}^{RW}.\frac{1}{E_t} - r_{t-1}^{RW}.Bb_{s,d_{t-1}}^{AR} \quad (181)$$

$$KA_t^{AR} = \Delta Bb_{s,d_t}^{RW/AR} + \Delta Bb_{s,p_t}^{RW} - \Delta Bb_{d,d_t}^{AR} - \Delta USD_h^{AR} - \Delta USD_{cb_t}^{AR} \quad (182)$$

$$KA_t^{RW} = \Delta Bb_{s,d_t}^{AR} + \Delta USD_{s,cb_t}^{AR} + USD_{s,h_t}^{AR} - \Delta Bb_{d,d_t}^{RW/AR} - \Delta Bb_{d,p_t}^{RW} \quad (183)$$

If the model is consistent, then it should happen that:

$$CA_t^{AR} + KA_t^{AR} = 0$$

$$CA_t^{RW} + KA_t^{RW} = 0$$

Another important condition that is derived from the matrix of stocks and that has to be fulfilled is the one that states that aggregate wealth of the world economy should be equal to the aggregate capital stock. In other words, financial assets do not constitute a source of net wealth for the economy as a whole since every financial asset is matched by a financial liability of the same value. Therefore:

$$\frac{Vh^{AR} + Vf_A^{AR} + Vf_N^{AR} - B_s^{AR} + Vcb^{AR}}{E} + Vh^{RW} + Vf_A^{RW} + Vf_N^{RW} - B_{s,d}^{RW} + Vcb^{RW} = \frac{K^{AR}}{E} + K^{RW}$$

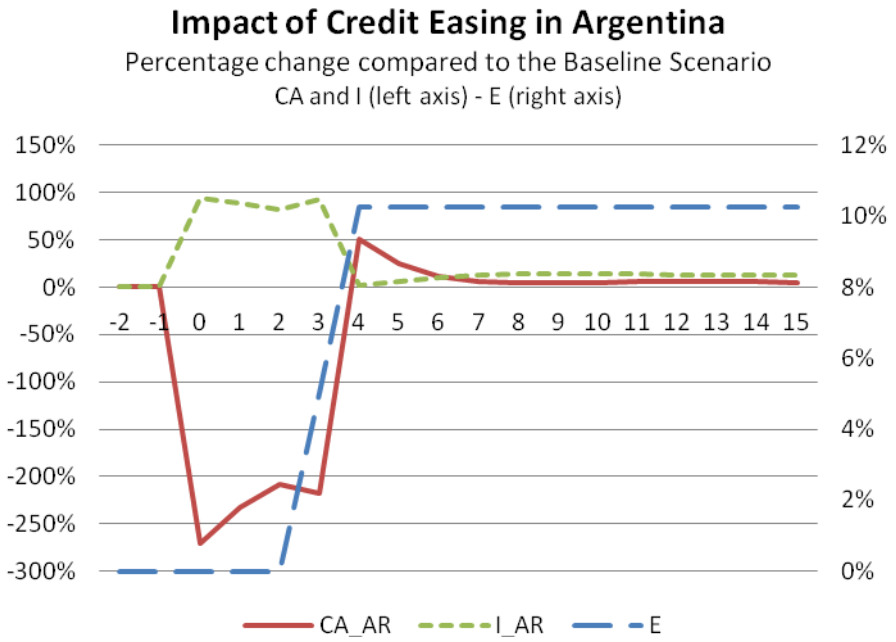
Finally, given that the supply side has been described more in detail compared to traditional SFC models, it is worth verifying that global supply is equal to global demand.

$$\frac{Y_A^{AR} + Y_{IC}^{AR} + Y_N^{AR}}{E} + Y_A^{RW} + Y_{IC}^{RW} + Y_N^{RW} - \frac{C_{AR} + ICA_{AR} + ICN_{AR} + IA_{AR} + IN_{AR} + G_{AR}}{E} - C_{RW} - ICA_{RW} - ICN_{RW} - IA_{RW} - IN_{RW} - G_{RW} = 0$$

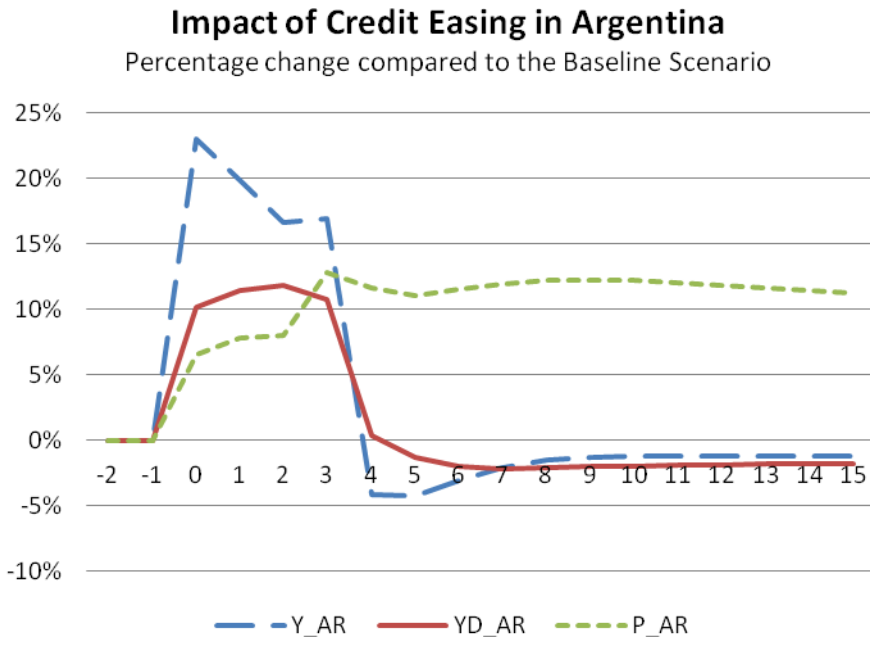
Thirlwall's Law: An Experiment applied to Argentina

In order to provide the reader with some ideas about the application of SFC models in general and this SPKSFC model in particular, we will carry out a simple experiment. First of all, it is worth clarifying some methodological issues. The model defined in equations (1 – 179) is a system that combines recursive and simultaneous equations. Given the values of the parameters (that should be calibrated in such a way that the simulated economy resembles the actual economy) and the starting values of the exogenous and endogenous variables, a baseline scenario can be obtained by solving the model using any algorithm that can deal with this type of system of equations (Broyden, Newton, Gauss-Seidel, etc.). Once a desired baseline scenario is obtained, a parameter or an exogenous equation can be shocked in order to examine what the impact on the endogenous variables is. A baseline scenario can also be used to address where the economy is going if everything (i.e., parameters and exogenous equations) is kept constant over time.

In order to explore one of the structuralist features of the model, we will examine the impact of a sudden easing on credit conditions in Argentina. Thus, we will depart from a baseline in which there is credit rationing and suddenly, for whatever reason (it may be an improvement of the institutional setting of the country, it may be a program launched by the government, etc.), credit constrains disappear. We expect that in such a situation investment will increase since desired and effective investment will become equal. However, this policy may have side-effects that could turn out to be very important. These effects are the ones that we want to analyze using a SFC framework. Before presenting the results of this experiment, it is worth noting that the shock consists of the easing of credit constrains until side-effects become significant and start affecting the economy. When that happens, we exogenously decide to reintroduce credit constrains assuming that "good times" are over.



The graph shows that when in credit constrains are eliminated in t=0, investment almost doubles. Simultaneously, the current account decreases five-fold. This is reasonable since many of the capital goods comprised in investment expenditure are imported. Moreover, the increase in investment results in a higher level of activity, which in turn implies a higher level of disposable income (see the graph below). Part of this income is used to purchase foreign goods by domestic households. Thus, if the import elasticities of the country are large enough, the country may encounter the so-called external constraint (Diamand, 1973) or balance-of-payments-equilibrium growth rate (Thirlwall, 1979) relatively soon. In the case of this simulation, Argentina hits the external constraint three periods after the shock, i.e., the stock of reserves held at the central bank can cope with three consecutive periods of current account deficits of this size – afterwards, it no longer has the ability to maintain the peg and a 5% devaluation is introduced. However, this initial devaluation is not sufficient to discourage imports since the structure of the model is such that the absence of substitution between domestic and foreign intermediate and capital goods requires that a certain amount of imports is purchased. Thus, a devaluation may be counterproductive in the sense that it may bring about an even worse result for the current account. This is exactly what happens in t=3, when the current account slightly worsens following the 5% devaluation. Under this setting of the model, the only way a country has to alleviate the external constrain is to grow at a slower pace, as suggested by Thirlwall. This is proven in t=4, when credit is exogenously constrained again (like it was in the baseline scenario) and the current account reverses completely. Given the cumulating depletion of foreign reserves, the exchange rate depreciates again by 5%. Thenceforth, all the variables reach a steady state that is very close to the baseline.



The above graph shows that the trajectories of both real income and disposable income are highly correlated to investment (which was plotted on the previous graph), being disposable income less sensitive to the latter. It is also interesting to see how prices behave. Before the devaluation (i.e., between t=0 and t=2) the increase in the price level is due to the increase in the price of "A" as a result of the higher demand (in absolute terms) by households. Recall that prices of "N" and "IC" goods were set exogenously by firms, whereas the price of "A" was such that any excess demand was cleared. In t=3 and t=4 the devaluation takes place, leading to an increase in the domestic price level as a result of both, more expensive imported "N" and "IC" goods and a higher international price of "A". From t=5 onwards, no major changes take place in the economy since the exchange rate is kept constant and investment is brought back to the credit-constrain level. Therefore, the price level continues growing at an almost constant rate which is given by the continuous interactions between firms and labor unions.

This experiment presented above is very simple and constrained by the structure of the model. Although this first version of the SPKSFC model incorporates many interesting contributions of the Structuralist school, some properties of the model need to be developed more in detail. For instance, some kind of (limited) substitution of "N" goods between the countries should be allowed for, in order to let Argentina export more than just "A" goods. This may change significantly the results of the simulation presented above, since the devaluation may lead to an improvement on the current account as a result of higher exports and lower imports of the "N" goods that can be substituted. The calibration of the model should also be refined in such a way that shocks yield more realistic impacts (note that in our simulation credit easing led to a 100% increase in investment and, given the investment to GDP ratio, a 23% increase in GDP). But still, this experiment was useful to prove the existence of Thirlwall's Law

within a SFC model and to make a case for structural reforms that allow developing countries to grow at high rates without needing to either devaluate their currencies or pushing the brake after a short period of growth.

Conclusion

In this first version of the SPKSFC model we aimed at laying the foundations for a series of studies aimed at addressing the dynamic macroeconomic performance of developing countries, where many structural constrains may require more detailed models than the ones that have been hitherto developed in the SFC literature. These foundations consist of a SFC model that incorporates many of the features that have been playing an important role in developing countries during the last century, such as credit constrains, high import elasticities, agricultural-based export-led growth strategies, lack of trust in the domestic currency, an important part of the external debt which is denominated in foreign currency, etc. When simulating the model some of these features turn out to behave as the historical evidence has shown, which constitutes a reason for optimism regarding the potential of these models. However, in order to be able to use a SPKSFC model to examine the behavior of developing countries there is still a long way to go regarding the specification of the economic structure and the calibration of the parameters.

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